



**[4910-13]**

## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 25**

#### **[Docket No. FAA-2012-1292; Special Conditions No. 25-485-SC]**

**Special Conditions:** Embraer S.A., Model EMB-550 Airplanes; Electrical/Electronic Equipment Bay Fire Detection and Smoke Penetration.

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Embraer S.A. Model EMB-550 airplane. This airplane will have novel or unusual design features, specifically distributed electrical and electronic equipment bays in pressurized areas of the airplane. Older transport category airplane electrical/electronic equipment bay installations are located in the lower lobe where the flight crew could determine the origin of smoke or fire by a straightforward airplane flight manual procedure. In distributed electrical/electronic bay installations it is not as straightforward. The FAA has no requirement for smoke and/or fire detection in the electrical/electronic equipment bays. To ensure effective mitigation of fires, the FAA proposes these special conditions. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** Effective [Insert date 30 days after date of publication in the *Federal Register*].

**FOR FURTHER INFORMATION CONTACT:** Robert C. Jones, FAA, Propulsion and Mechanical Systems Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-1234; facsimile 425-227-1149.

**SUPPLEMENTARY INFORMATION:**

**Background**

On May 14, 2009, Embraer S.A. applied for a type certificate for their new Model EMB-550 airplane. The Model EMB-550 airplane is the first of a new family of jet airplanes designed for corporate flight, fractional, charter, and private owner operations. The airplane has a conventional configuration with a low wing and T-tail empennage. The primary structure is metal with composite empennage and control surfaces. The Model EMB-550 airplane is designed for 8 passengers, with a maximum of 12 passengers. It is equipped with two Honeywell HTF7500-E medium bypass ratio turbofan engines mounted on aft fuselage pylons. Each engine produces approximately 6,540 pounds of thrust for normal takeoff. The primary flight controls consist of hydraulically powered fly-by-wire elevators, aileron and rudder, controlled by the pilot or copilot sidestick.

The Model EMB-550 airplane has electrical/electronic equipment bays distributed throughout the airplane; three of them are in the pressurized area. The current airworthiness requirements do not contain adequate or appropriate safety standards regarding smoke/fire detection and protection against penetration of hazardous quantities of smoke from equipment bays into occupied areas of the airplane for this type of airplane configuration.

## **Type Certification Basis**

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Embraer S.A. must show that the Model EMB-550 airplane meets the applicable provisions of part 25, as amended by Amendments 25-1 through 25-127 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model EMB-550 airplane because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Model EMB-550 airplane must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36 and the FAA must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the “Noise Control Act of 1972.”

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

## **Novel or Unusual Design Features**

The Model EMB-550 airplane will incorporate the following novel or unusual design features: distributed electrical and electronic equipment bays that were not envisioned at the time this rule was made.

## Discussion

In general, smoke and fire detection systems are designed to:

- Automatically shut off power to the affected equipment,
- If necessary, reconfigure the environmental control systems to control any smoke resulting from a fire or overheat condition, and
- Alert the flight crew to the existence of the fire.

Most airplanes certified under part 25 have one or two electrical equipment bays located in the lower lobe, adjacent to pressure regulator/outflow valves or vents. If a fire occurs in an electrical equipment bay, any smoke is drawn toward the outflow valves or vents and is discharged from the airplane without entering occupied areas. In the event of a smoke or fire in one of the electrical equipment bays, the procedures to isolate the bay on some airplanes requires the flight crew to use trial and error to determine whether or not the source is in a particular electrical equipment bay. However, with this approach, the flight crew does not know where the fire or smoke is because it is difficult to identify the source, especially during changes of phases of flight (e.g., climbing or descending) or system transients (e.g., changes in the airflow from the environmental control system).

This trial-and-error approach may be acceptable for aircraft with no more than two electrical equipment bays, both located in the lower lobe. In this case, a fire in an electrical equipment bay is in either one bay or the other. However, for an aircraft with three or more electrical equipment bays, in the time it takes to determine the source of smoke, the fire could spread, generating even more smoke and damage.

In the Model EMB-550 airplane, electrical equipment bays are distributed throughout the airplane in the pressurized compartment. Section 25.857 requires that cargo compartments have means to prevent hazardous quantities of smoke or fire extinguishing agent from penetrating into occupied areas of the airplane. However, the applicable airworthiness regulations do not address the following:

- Preventing hazardous quantities of smoke or extinguishing agent originating from the electrical equipment bays from penetrating into occupied areas of the airplane; or
- Installing smoke or fire detectors in electrical equipment bays.

The FAA determined that the Model EMB-550 needs a means to detect smoke or fire in each electrical equipment bay that is located in the pressurized cabin. This means must indicate in which bay the smoke or fire occurs, and ensure that the flight crew can depower it. For situations in which it may be impossible for the flight crew to shut down all the equipment in the bay due to the use of critical or essential equipment located in it, Embraer S.A. shall conduct an analysis to:

- Specify the criteria for shutting down specific electrical equipment in the electrical equipment bay that can be shut down,
- Demonstrate that remaining electrical equipment is protected against fire propagation, such as thermal protection, fire containment, and other systems as addressed in Advisory Circular 25-16, *Electrical Fault and Fire Prevention and Protection*, dated April 5, 1991.

The criteria developed for aircraft designs that incorporate distributed electrical/electronic equipment bays are based upon existing smoke/fire detection and smoke

penetration guidance and acceptable past practices. Sections 25.831(b), 25.831(c), 25.831(d), and 25.869(a) provide the general requirements that apply to electrical/electronic equipment smoke penetration and evacuation. Flight tests are conducted to demonstrate compliance; however, the amount of smoke generated and flight test conditions have been highly variable.

The special conditions below require that there must be a means to detect smoke or fire in each electrical/electronic equipment bay located in the pressurized compartment. They also include requirements to prevent propagation of hazardous quantities of smoke or fire extinguishing agent throughout the passenger cabin.

### **Discussion of Comments**

Notice of proposed special conditions No. 25-12-17-SC for the Embraer S.A. Model EMB-550 airplanes was published in the *Federal Register* on December 19, 2012 (77 FR 75071). No comments were received, and the special conditions are adopted as proposed.

### **Applicability**

As discussed above, these special conditions are applicable to the Model EMB-550 airplane. Should Embraer S.A. apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

### **Conclusion**

This action affects only certain novel or unusual design features on one model of airplanes. It is not a rule of general applicability.

### **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

## **The Special Conditions**

Accordingly, the Federal Aviation Administration (FAA) proposes the following special conditions as part of the type certification basis for Embraer S.A. Model EMB-550 airplanes.

1. Requirements to prevent propagation of smoke that originates in electrical equipment bays from entering the passenger cabin and flight deck:

a. To prevent such propagation, means to prevent hazardous quantities of smoke originating from the electrical equipment bays from incapacitating passengers and crew must be demonstrated. The demonstrations must include flight tests, and shall be conducted for all dispatchable system configurations.

b. A small quantity of smoke may enter an occupied area only under the following conditions:

i. The smoke enters occupied areas during system transients from below the deck or main deck sources. No sustained smoke penetration beyond that from environmental control system transients is permitted,

ii. Penetration of the small quantity of smoke is a dynamic event, involving either dissipation or mobility. Dissipation is rapid dilution of the smoke by ventilation air. Mobility is rapid movement of the smoke into and out of the occupied area. In no case should a light haze indicative of stagnant airflow form, as this indicates that the ventilation system is failing to meet the requirements of 14 CFR 25.831,

iii. The smoke from a source below the main deck must not rise above armrest height on the main deck, and

iv. The smoke from a source in the main deck must dissipate rapidly via dilution with fresh air and be evacuated from the airplane. The Airplane Flight Manual (AFM) must include procedures to evacuate smoke from the occupied areas. To demonstrate that the quantity of smoke is small, a flight test must be conducted which simulates the emergency procedures used in the event of a fire during flight, including the use of  $V_{MO}/M_{MO}$  descent profiles and a simulated landing, if such conditions are specified in the emergency procedure.

2. Requirement for smoke or fire detection in electrical/electronic equipment bays: A smoke or fire detection system compliant with §§ 25.855(a), (b), (c), and (d); and § 25.858 must be provided for each electrical/electronic equipment bay in the pressurized cabin. Each system must provide a visual indication to the flight deck within one minute after the start of a fire. Airplane flight tests must be conducted to show compliance with these requirements, and the performance of the detectors must be shown in accordance with Advisory Circular 25-9A, *Smoke Detection, Penetration, and Evacuation Tests and Related Flight Manual Emergency Procedures*, or other means acceptable to the FAA.

3. Requirement for AFM procedures safety analysis: It shall be demonstrated that the AFM procedures to shut down electrical/electronic equipment bays, or part of them, in case of smoke/fire detection, do not compromise the safe operation of the aircraft. If a procedure requests to shut down only part of the equipment, the remaining equipment shall be incorporated with safety precautions against fire propagation.

Issued in Renton, Washington, on February 26, 2013.

Ali Bahrami  
Manager, Transport Airplane Directorate  
Aircraft Certification Service



[FR Doc. 2013-04854 Filed 03/01/2013 at 8:45 am; Publication Date: 03/04/2013]